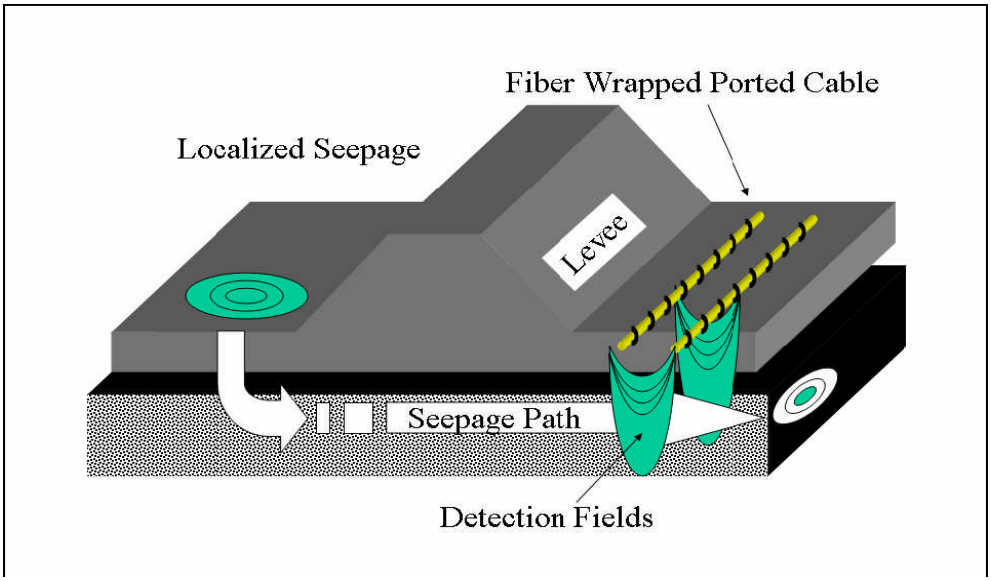
US Army Corps of Engineers®

Flood&Coastal Storm Damage Reduction R&D Program

Ported Cable Deployment for Seepage Detection in Dams and Levees

Description

The U.S. Army Engineer and Research Center (ERDC) Geotechnical and Structures Laboratory (GSL), Information and Technology Laboratory (ITL), along with the Cold Regions Research Engineering Laboratory (CRREL) are using a full-scale test site to investigate an innovative deployment of ported cables along with optic fibers to monitor seepage paths and movement in a small section of a levee. Data from the ported cables are used to detect seepage under a levee. The ported cable operates by detecting disruption of electrical fields occurring when water is introduced to the soil. Optic fibers are used to detect movement due to displacement of subsurface material during piping or structural instability resulting from surface erosion. The performance of the optic fiber and ported cables are reported along with guidance on methods to emplace and monitor the system.



Deployed System

Benefits

The system's ability to isolate the location of seepage paths will result in saving levee boards millions of dollars in costs through early detection and remediation. Corps Districts, the Federal Emergency Management Agency (FEMA), and other Federal, state, and local agencies involved with maintenance, rehabilitation and monitoring of levee systems will be the main beneficiaries of this program.

Status

A full-scale test site is under investigation, which has a history of localized seepage events over the past 10 years. Installation of the ported cables and optic fibers in the toe of the levee system is expected to identify the exact location of anomalous seepage areas. The more measurements made over time will improve the detection capability and the accuracy

of the seepage flow evaluation. While the ported cable will detect changes in levels of soil moisture, the optic fibers will detect displacement in the levee. Displacement of large amounts of subsurface sand will occur due to piping. Calibration of the seismic readings of the optic fibers with the volume of displace sand will provide information regarding the structural stability of the levee and the probability of collapse. This information will provide levee boards and engineer companies useful design information for remediation of seepage. The system, if combined with telemetry, can provide an early warning system suggesting when a levee is near failure.

Distribution Source(s)

N/A.

Available Documentation

Johansson, S., and Farhadiroushan, Mahmoud, (2005). *Seepage and Strain Monitoring in Embankment Dams Using Distributed Sensing in Optical Fibers- Theoretical Background and Experiences from Some Installations in Sweden*. CEATI- Geophysical Methods for Assessing Seepage and Internal Erosion in Embankments, International Symposium on

Dam Safety and Detection of Hidden Troubles of Dams and Dikes, November 1-3, 2005 Xi'an, China Bahar, Ezekiel and Saylor, John. A feasibility study to monitor soil moisture content using microwave signals. *IEEE transactions on Microwave Theory and Techniques.* MTT-31 (7), July 1983 pp 533- 541.

Available Training

N/A.

Available Support

N/A.

Application

The ported cable system has been deployed in the past for agricultural purposes by Bahar and Saylor (1983) where monitoring of changing soil conditions was used for agricultural decision-making. Johansson, S., and Farhadiroushan, Mahmoud (2005) utilized an optic fiber system for continuous monitoring of levees to detect seepage paths that produce localized temperature changes. A combination of optic fibers and ported cables has been developed for reporting levee stability. At this time, the system has been buried at the Buck Chute, Eagle Lake, Mississippi site for one year without disruption. The system is expected to begin reporting data back to a centralized station in 2008.

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Partners

The U.S. Army Engineer and Research and Development Center (ERDC) Geotechnical and Structures Laboratory (GSL), Information and Technology Laboratory (ITL), Cold Regions Research Engineering Laboratory (CRREL), the Mississippi Levee Board, USACE, Vicksburg District